An Economic Perspective on Green Energy Market in Romania

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Abstract	*Producing energy from renewable sources represents an essential component of energy policies at a national level and it leads to important savings of fossil fuel and primary energy. This article investigates the development of renewable energy in terms of energy production and consumption, on the one hand, and on the other hand, it presents a model to forecast the region's evolution of renewable energy diffusion (up to three years). Statistics proved that Romanian consumers have a key role in developing the green energy market, but it is also very important to ensure the ability of renewable energy suppliers to accommodate to this demand. Sample data and econometric regression analysis were applied to delineate factors influencing Romanian consumers' awareness about renewable energy. The research findings from this regression analysis highlight a strongly connection between those who bear the cost of renewable energy development and the actual beneficiaries of a clean environment to identify the major drivers and barriers for renewable energy diffusion in Romania. The results of this forecast regions analysis of renewable energy could be used for further research in the area of implementing renewable energy projects for the urban development of the regions.*
Key words	Renewable energy, clean environment, green energy market
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1. Introduction

In light of climate change, the growing electric energy security importance creates significant economic consciousness. In this context, the natural environment protection is a global issue and the special definition of investment must take into account both the costs and effects of investments to more and more natural environment (Ellabban *et al*., 2014). Therefore, investments must be integrated into the ongoing development of society, especially factual theory, the models that ensure environmental protection, ecological balance, ensuring national security objectives of sustainable development (Oncioiu *et al*., 2013).

Moreover, the National Regulatory Authority for Energy (ANRE) and Transelectrica report data refers to the plants to produce energy from renewable sources existing at national level. The differences between the plants reported by ANRE and Transelectrica are determined by the state of these plants to produce green energy. Anyway, while ANRE has already reported functioning plants which qualify to receive green certificates, Transelectrica reports green energy production plants which can only develop after receiving technical connection approval, but which are not fully functional and do not receive green certificates (Boteanu, 2016; Rusu and Butunoiu, 2014).

The goal of this research is to investigate the development of renewable energy in terms of energy production and consumption, on the one hand, and on the other hand, it presents a model to forecast the region's evolution of renewable energy diffusion, focusing on renewable energy.

The structure of this article is as follows: Firstly, the study discloses an analysis regarding the development of renewable energy in terms of energy production and consumption and results in a certain time in the energy from renewable sources. The next sections describe the research methodology, with associated findings and provide a discussion of the results. The final section presents the conclusions reached from the study.

2. Brief overview of renewable energy in Romania

A number of studies have shown that temperature increases harm real economic activity (Dell *et al.*, 2012; Knight and Schor, 2014). The review of the main legal regulations that govern the green energy production sector reveals the complexity of the sector on the one hand, and the well-defined legal character for the actors on this market, on the other hand. Based on 2009/28/EC Directive, application of promotion schemes was implemented in order to reach national and Community targets, regarding extensive use of energy produced from renewable sources.

A peculiarity regarding the projects of green energy production is given by their big dimension, especially in the wind power area (approximately 50 MWh), which is above average dimension at European level (Zhang *et al*., 2015). The explanation for the spread of such large investment is linked to low population density in rural areas of Dobrogea, the main area of Romania's wind resource and the favourite location of green energy project developers (Rusu and Butunoiu, 2014).

In the context of the explosive development of green energy plants, the Romanian Government promoted during 2013, No.57/2013 OUG which modifies the stipulations of 220/2008 Law. Consequently, the 57/2013 OUG brings the following

modifications to the green certificates support scheme: during 1st of July 2013 - 31st of December 2016, the granting of the entire number of green certificates /MWh for some specific technologies is postponed, as followed: new hydro electrical plants (with installed power smaller than 10 MWh) - one green certificates postponed; wind power - one green certificates postponed; solar - two green certificates postponed (Stamatescu *et al.*, 2017).

The National Regulatory Authority for Energy (ANRE) regulates, monitors and controls functioning of the energy sector and energy and natural gases markets, with a view on competition, transparency, efficiency and consumers` protection. More than this, it implements and monitors measures of energy efficiency at national level and it promotes the use of renewable energy for final consumers (Haara and Marinescu, 2011).

According to primary and secondary legislation in force, the Market Operator of Electricity and Natural Gases (in Romanian OPCOM) plays the role of administrator of electricity market, offering an organized, viable and efficient framework for the conduct of commercial transactions in the wholesale electricity market, in terms of consistency, fairness, objectivity, equidistance, transparency and non–discrimination (Cicea *et al.*, 2014).

For designing Romanian future with renewable energy, in case of wind power parks for example, it is necessary to remove from farm and use classification of those surfaces directly affected by constructions (such as those corresponding to turbine foundations, transformers, access roads, electricity lines etc.). For photovoltaic parks, in the absence of legal provisions, the authorities 'practice varies considerably: the removal from farm-use classification of the entire surface is required, or only of those surfaces for the positioning of photovoltaic panels on the soil, or even only of the surface occupied by the metallic posts of the metallic structures sustaining the panels.

In order to connect a green energy plant to the public network, the issuing of a technical connection approval is needed from the transmission or distribution operator. The technical connection approval is issued based on the connection studies approved by the network operators. The access can be denied only in case of a lack of capacity of the network which cannot take over the energy produced. The technical connection approval has an availability of 25 years, provided that in three or six months (depending on the electric voltage of the connected network) after the permit was issued to sign the connection contract with the competent network operator and to pay for the connection fee. On demand, it is possible to extend this term with three or six months. The connection fee represents the value of the connection work, so the value can be substantial.

3. Methodology of research

In order to achieve the forecast of the evolution of renewable energy in terms of energy production and consumption by the regions of the Romanian green energy market, we will describe the Markov chain method combining the theory with the practice. Thus, a Markov chain is define by the vector of initial state and of the transition probability matrix. The vector of initial state corresponds to the structure of the studied process for the last year, when the data are known (i.e. the data are real). The elements of the transition probability matrix are estimated in practice with the relative frequency components of the studied process (which are expressed by empirical data). The economic data used in modelling are taken from the Annual Activity Report of the National Regulatory Authority for Energy (National Regulatory Authority for Energy, Annual activity report, 2016).

To estimate the medium-term prognosis on renewable energy segment of Romania's region, we used a prognosis model whose algorithm is based on the theory of Markov chains (Oncioiu, 2013):

$$S_1 = S_0 * P \tag{1}$$

$$S_2 = S_1 * P = S_0 * P_2 \tag{2}$$

$$...$$

$$S_n = S_{n-1} * P = S_0 * P_n \tag{3}$$

Where:
$S_0, S_1, S_2 .... S_n$ represents the structure of renewable energy by regions
$P, P_2 .... P_n$ represents the matrix of transition probabilities from one region to another in the next years.

Performing calculations by this algorithm, one obtains the distribution prognosis of renewable energy by regions, depending on the region's evolution of renewable energy diffusion (in terms of energy production and consumption) until the year 2019.

By direct summation of the elements of the transition matrix for two consecutive years, the total transitions' matrix is obtained for the whole period 2006-2016. Based on this matrix one determines the stochastic matrix of transition probabilities for the period 2017-2019.

4. Results and discussions

For the purpose of the research, neither the first mentioned, nor this method is appropriate, because it would not allow the assessing of sensitive transition of renewable energy from one group to another. To achieve the purpose, the results are given in Table 1.

Table 1. Renewable Electricity produced in installations in correlation with Gross Electricity Consumption - Indicator (share)

Region	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
South-East	34.53	35.44	38.25	38.70	38.38	34.73	33.90	32.84	34.71	35.34	34.37
South-Muntenia	13.20	14.01	14.18	14.98	15.23	16.27	17.14	17.37	15.40	14.06	14.72
Bucharest-Ilfov	27.71	27.06	25.64	24.43	24.77	26.49	25.96	25.06	24.91	24.59	23.79
Centre	5.37	6.99	6.35	6.99	6.97	7.56	7.90	8.30	8.63	9.26	8.39
West	10.77	9.82	9.30	8.97	9.09	8.93	9.03	9.90	9.71	9.76	11.32
South-West Oltenia	1.27	1.38	1.04	0.95	0.80	1.12	1.10	1.40	1.38	1.37	1.56
North-West	6.45	4.55	4.18	4.23	4.07	4.18	4.21	4.26	4.33	4.65	4.77
North-East	0.70	0.75	1.06	0.75	0.69	0.72	0.76	0.87	0.93	0.97	1.08
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Elaborated by the authors using the input data from the Annual activity report of National Regulatory Authority for Energy (National Regulatory Authority for Energy, Annual activity report, 2016).

Then, we compute the structural deviations for each pair of consecutive years since 2006 to 2016 (see Table 2).

Table 2. Structural deviations for each pair of consecutive years

	South-East	South-Muntenia	Bucharest-Ilfov	Centre	West	South-West Oltenia	North-West	North-East
2006	34.53	13.20	27.71	5.37	10.77	1.27	6.45	0.70
2007	35.44	14.01	27.06	6.99	9.82	1.38	4.55	0.75
Deviations	0.91	0.07	- 0.65	- 0.26	0.50	- 0.29	- 0.32	0.04
Positive deviations	0.91	0.07	0.10	0.10	0.50	0.10	0.18	0.04
Share	0.459	0.135	0	0	0.257	0	0	0.050

Source: Elaborated by the authors.

Each negative deviation, recorded by a particular item will be distributed to all elements which have recorded positive deviations, proportional to the share of positive deviations when will determine the partial transition matrix. Next, we determine the transition probability matrix, which is obtained by dividing the elements of each line of the total transition matrix to its total value. Finally, applying the above formula we obtain the data from Table 3.

Table 3. The results of forecast for the evolution of renewable energy diffusion

The forecast	South-East	South-Muntenia	Bucharest-Ilfov	Centre	West	South-West Oltenia	North-West	North-East
2016	34.37	14.72	23.79	8.39	11.32	1.56	4.77	1.08
2017	34.01	16.05	23.21	6.02	12.31	2.57	4.73	1.10
2018	35.50	17.07	21.28	6.10	12.66	1.55	4.70	1.14
2019	35.58	15.03	22.46	6.24	13.33	1.54	4.63	1.19

Source: Elaborated by the authors.

The results of forecast for the evolution of renewable energy represent the impact of power electronics that can enable the proportionate share of renewable energy resources.

Nonetheless, the sustained development of the renewable and solar capacity to the detriment of those capacities for the production of green energy which is characterized by a higher capacity factor endangers all safe operation of the power system, from the reasons mentioned above. This strategic option is more motivated by the reduced specific costs for

renewable power equipment, which do not justify support by Green Certificates so highly. Incidentally, in the next period, a tendency to reduce further support through green certificates is anticipated for the ability to produce energy from renewable resources, based on the increasingly higher demands from major industrial consumers to maintain a competitively - priced electricity to preserve the competitiveness of industrial products.

5. Conclusions

The use of renewable energy could provide a long-term competitive economic advantage. Also, the use of the renewable energy available is needed mainly for the gradual replacement of energy produced from fossil fuels to clean energy, to help bring in business for some isolated areas.

It is of utmost importance to offer guarantees that, in time, the price of renewables will become cost effective and the use of support schemes is going to be limited to technologies and areas that still need their use. These schemes should be elaborated in a manner permitting to avoid overcompensation, to improve cost efficiency and to encourage the significant reduction of greenhouse gas emissions.

The specificity for Romania regarding the production of the green energy is the average dimension much higher of the wind farms as compared to other states (40 MWh installed as compared to 15 MWh European average). This resides in the greater availability of large fields and wind farm placed in these areas with a great potential for renewable energy production, which is sparsely populated, away from the urban sprawls.

The investments to produce green energy were focused on wind resources, thus motivated by the lack of technical sophistication and the short period of implementation, either using photovoltaic resources or motivated by the generous financial support through the green certificate (GC) scheme. Interestingly, although the specific costs of investment occurred in the case of biomass and micro hydro are compensated by the higher number of operating hours, the support scheme through green certificates supported by a larger number of GC capabilities photovoltaic (6GC) and reported to cost investment, wind capacities (2 GC).

According to the results of the study, in the near future, analysing the number of certificates granted or requested, shows that it is anticipated that a further growth at a very fast pace of the production capacities of green energy sources, both solar and micro hydro, a slowdown in wind farms capacities and moderate growth in terms of the capacities using biomass. As an example, for the wind farms, the return of investment period doubles from eight to fifteen years, under the new legal stipulations to approve green certificates, but it remains almost unchanged for the green energy capacities using biomass.

References

Boteanu C. M. (2016). Balanced Scorecard in the Romanian Energy Sector, Lap Lambert Academic Publishing Gmbh & Co.KG, Germany, pp. 85–92.

Cicea C., Marinescu C., Popa I., Dobrin C. (2014). Environmental efficiency of investments in renewable energy: Comparative analysis at macroeconomic level, Renewable and Sustainable Energy Reviews, vol. 30, pp. 555–564.

Dell M., Jones B. F., Olken B. A. (2012). Temperature shocks and economic growth: Evidence from the last half century, American Economic Journal: Macroeconomics, vol.4, pp. 66–95.

Ellabban O., Abu-Rub H., Blaabjerg F. (2014). Renewable energy resources: Current status, future prospects and their enabling technology, Renewable and Sustainable Energy Reviews, vol. 39, pp. 748–764.

Haara L. N., Marinescu N. (2011). Energy policy and European utilities' strategy: Lessons from the liberalisation and privatisation of the energy sector in Romania, Energy Policy, vol. 39/issue 5, pp. 2245–2255.

Knight K.W., Schor, J.B. (2014). Economic Growth and Climate Change: A Cross-National Analysis of Territorial and Consumption-Based Carbon Emissions in High-Income Countries, Sustainability, vol. 6, pp. 3722-3731.

National Regulatory Authority for Energy (2016). Annual activity report 2016, Romania, vol. 12.

Oncioiu I. (2013). Current challenges and future trends for Romanian small and medium enterprises: an empirical studies, Advances in Management & Applied Economics, vol. 3 /issue 3, pp. 67-83.

Oncioiu I., Boteanu C.M., Petrescu M. (2013). Green energy from agriculture and Romanian firms' competitive advantage, Romanian Biotechnological Letters Journal, vol. 18 /issue 6, pp. 8761-8768.

Rusu L., Butunoiu D. (2014). Evaluation of the wind influence in modeling the Black Sea wave conditions, Environment Engineering Management Journal, vol.13, pp. 305-314.

Stamatescu I., Arghira N., Făgărăşan I., Stamatescu G., Iliescu S.S., Calofir V. (2017). Decision Support System for a Low Voltage Renewable Energy System, Energies, vol. 10, pp. 118-121.

Zhang H., Zheng Y., Zhou D., Zhu P. (2015). Which Subsidy Mode Improves the Financial Performance of Renewable Energy Firms? A Panel Data Analysis of Wind and Solar Energy Companies between 2009 and 2014, Sustainability, vol. 7, pp. 16548-16560.